

REMARKS/ARGUMENTS

Claims 1, 3-6, 8-13, and 20-22 were pending in this application. According to the most recent Office Action dated December 3, 2002, claims 1, 3-6, 8-13, and 20-22 were rejected. The Board of Patent Appeals and Interferences affirmed this rejection in its Decision dated August 17, 2005. Applicant has amend claims 1, 4, 6, 9, and 10 to clarify applicant's invention. Applicant has amended claim 8 to depend from claim 4 rather than claim 7, which was previously canceled. Accordingly, claims 1, 3-6, 8-13, and 20-22 are under consideration.

Rejection of Claims 1, 3-6, 8-13, and 20-22

The Examiner rejected previously presented claims 1, 3-6, 8-13, and 20-22 as unpatentable, 35 U.S.C. 103(a) in view of Floyd et al., patent 6,090,716 (hereinafter Floyd '716). Beginning with independent claim 1, it recites a P-channel MOSFET and in particular, recites a "trench-type power MOSFET having a vertical invertible channel composed of N type conductivity material disposed between a source region and a drain region ... said vertical invertible channel material having a constant concentration along its full length." The Examiner indicated that Floyd '716 also teaches in Figure 1 and Figure 10 trench-type power MOSFETs that differ from the MOSFET of claim 1 only in that the polarity of the devices is reversed. Here, the Examiner indicated that in view of Floyd et al., patent 6,069,043 (hereinafter Floyd '043) and Darwish et al., patent 5,674,766 (hereinafter Darwish '766) it would be obvious to one skilled in the art to reverse the polarity of the devices of Floyd '716 Figures 1 and 10, thereby teaching claim 1. The Board affirmed this rejection in its Decision dated August 17, 2005.

In response to the Examiner's rejection, applicant has amended claim 1 to recite that the power MOSFET also includes "a source contact connected to at least said source region; and a drain contact made of metal and connected to a bottom surface of said drain region," thereby further clarifying applicant's invention. Support for this amendment can be found at page 10, lines 15-18 of the Specification.

Applicant respectfully submits that in addition to the polarity difference, the devices shown in Floyd '716 Figure 1 and Figure 10 are structurally different from the device recited by amended claim 1 and as such, even if it is obvious to reverse the polarity of the devices shown in these Figures, the resulting devices would not be applicant's invention as recited by claim 1.

Specifically, beginning with the device of Floyd '716 Figure 1, as indicated at column 1, lines 16-46, this device is an INVFET structure and is more fully described in Floyd et al., patent 5,592,005 (hereinafter Floyd '005). As described in Floyd '005, the P channel region 24 of the Figure 1 device is "formed by diffusion [and] hence does not exhibit uniform doping" (see, Floyd '005, column 1, lines 34-42). This is contrary to amended claim 1, which recites that the "vertical invertible channel material [has] a constant concentration along its full length." Accordingly, even if the polarity of the device shown in Floyd '716 Figure 1 is reversed, this device is still not applicant's invention as recited by claim 1.

Turning to Floyd '716 Figure 10, Floyd teaches that this device is an INVFET structure of the type shown in Figure 1 but that this device now has a channel region 52 with a constant concentration, similar to claim 1. Notably, however, Floyd also teaches that on the backside of substrate 40 of the device is an undoped polysilicon layer 60 (see Floyd '716, column 2, lines 53-54 and 65-67). It appears to applicant that because of polysilicon layer 60, the device of Figure 10 is either a planar-type device or alternatively, is a vertical device with the polysilicon layer 60 acting as the drain contact for the device. Notably, if the device is a planar device, even if the polarity of the device is reversed, the device is structurally and operationally different from the device of claim 1, which is a vertical device.

Alternatively, if the device shown in Figure 10 is a vertical device with the polysilicon layer 60 acting as a drain contact, this configuration is also structurally different from the device of claim 1, which now recites a "drain contact made of metal and connected to a bottom surface of said drain region." In addition, such a configuration is also operationally different from the present invention in that it would be difficult to form good ohmic contact with an undoped polysilicon layer, as compared to the metal contact of the device of claim 1, thereby increasing the ON resistance of the device. Notably, applicant's invention is specifically directed at a P channel device with reduced ON resistance. Accordingly, even if the polarity of the device shown in Floyd '716 Figure 10 is reversed, this device is structurally and operationally different from applicant's invention as recited by claim 1.

Applicant further submits that if the device shown in Figure 10 is a vertical device with a polysilicon drain contact, it is nonobvious to replace this polysilicon layer with a metal contact like that of claim 1. First, nowhere does Floyd '716 teach or suggest that this layer may be doped to improve its conductivity or that this layer can be replaced with a metal layer. Second, applicant notes that Floyd '005, to which Floyd '716 makes reference, also teaches an INVFET type device (see Floyd '005, Figure 3) with a channel region of constant concentration and a

metallized drain contact. Nonetheless, Floyd '716 fails to teach or suggest that the configuration of the Floyd '005 device can also be used for the device of Floyd '716 Figure 10. Accordingly, it appears to applicant that polysilicon layer 60 is necessary for the proper operation of the device of Figure 10. As such, applicant respectfully submits that Floyd '716 teaches away from the use of a bottom side metal contact and that it is thereby nonobvious to replace the polysilicon layer with a "drain contact made of metal," as recited by claim 1.

For the foregoing reasons, applicant respectfully submits that Floyd '716 fails to teach or suggest amended claim 1, in addition to claims 3 and 20, which depend therefrom.

Turning to independent claims 4 and 9, these claims are similar to claim 1, reciting an "epitaxially deposited N type" layer that has "a substantially constant concentration." In addition, applicant has similarly amended these claims to recite "a drain contact made of metal and connected to a bottom surface of said substrate," thereby further clarifying applicant's invention. Accordingly, claims 4 and 9, together with claims 5-6, 8, 10-13, and 21-22, are novel and nonobvious in view of Floyd '716 for the same reasons as set forth above for claim 1.

Turning to dependent claims 6 and 10, the Examiner indicated that although Floyd '716 does not teach a source contact in contact with an epitaxial deposited layer, as recited by these claims, such a connection is well known in the art as evidenced by Floyd '043 Figure 12 and Darwish '766, Figures 1, 2, and 4. In response to the Examiner's rejection, applicant has amended claims 6 and 10 to clarify applicant's invention. Claims 6 and 10 now recite that the MOSFET further comprises "a plurality of spaced notches extending through said source regions and exposing said epitaxial deposited layer, wherein said source contact extends through said plurality of notches and is connected to said epitaxially deposited layer." Support for this amendment can be found in Figure 2 and at page 7, lines 10-19 of the Specification.

Applicant notes that Floyd '043 and Darwish '766 only teach a source contact connected to a channel region through a doped contact region. Neither reference teaches or suggests notches formed through the source region to expose the channel region and a source contact extending through the notches to connect to the channel region. As such, the combination of Floyd '716 and Floyd '043 or Darwish '766 fails to teach or suggest claims 6 and 10, and claims 11 and 13 which depend therefrom.

Conclusion

Since Floyd '716, Floyd '043, and Darwish '766 do not teach or suggest applicant's invention as now set forth in amended claims 1, 3-6, 8-13, and 20-22, applicant submits that

these claims are clearly allowable. Favorable reconsideration and allowance of these claims are therefore requested.

Applicant earnestly believes that this application is now in condition to be passed to issue, and such action is also respectfully requested. However, if the Examiner deems it would in any way facilitate the prosecution of this application, he is invited to telephone applicant's agent at the number given below.

EXPRESS MAIL CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail to Addressee (mail label # EV606188230US) in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on October 17, 2005:

Dorothy Jenkins

Name of Person Mailing Correspondence

Dorothy Jenkins
Signature

October 17, 2005

Date of Signature

Respectfully submitted,

Glen R. Farbanish

Glen R. Farbanish

Registration No.: 50,561

OSTROLENK, FABER, GERB & SOFFEN, LLP

1180 Avenue of the Americas

New York, New York 10036-8403

Telephone: (212) 382-0700

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